Farmers' Bulletin 1005
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Sweet Clover on Corn Belt Farms

SWEET CLOVER is now grown successfully on many farms in the corn belt, both in rotation and as a catch crop to be plowed under.

It has proved excellent for hay and pasture, and is unequaled by any other legume for soil improvement.

Sweet clover may be used to good advantage for silage, and on some farms, with proper management, it is a profitable seed crop.

Mixed with bluegrass, it makes a pasture of nearly double the carrying capacity of bluegrass alone.

The object of this bulletin is to present details of management and of the more important farm practices followed on some of the successful corn-belt farms on which sweet clover is grown as one of the principal crops of the rotation.

Cropping systems are outlined for farms of different types, and special attention is called to the three essentials of success in growing the crop—lime, inoculation, and scarified seed.

Office of the Secretary
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E. H. THOMSON, Acting Chief
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SWEET CLOVER ON CORN BELT FARMS.

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CONTENTS.

SWEET CLOVER AS A REGULAR CROP.

THE VALUE OF SWEET CLOVER has been demonstrated on numerous farms in the corn belt. Hitherto, however, it has been grown in this region mainly on odd fields, outside of any set rotation or cropping system. As yet, comparatively little attention has been given to fitting sweet clover into the farm system as one of the regular crops. It is the purpose of this bulletin to describe the cropping systems and farm practices followed on a few farms where the problems arising in this connection are being worked out satisfactorily. It is believed that corn-belt farmers who wish to grow sweet clover may save themselves much of the expense and trouble of experimenting by studying the methods of management followed on these farms and the way in which the crop is handled where it is used to best advantage.[1]

THREE THINGS ESSENTIAL TO SUCCESS WITH SWEET CLOVER.

The fact that sweet clover is found growing as a weed along a roadside is no indication that it will thrive in adjacent fields. Frequent trials have shown the folly of depending upon such indications. Success with sweet clover is rare unless three essentials of such success have been provided, namely, lime, inoculation, and scarified

[1] In addition to those whose names are mentioned in the text, the writers wish especially to give credit to Mr. Roy C. Bishop, county agent, Livingston county, Ill., and to Prof. H. D. Hughes, chief, division of farm crops, Iowa State College. Both men have given valuable assistance in furnishing the names of farmers who are growing sweet clover as a regular crop on their farms, as well as furnishing important information, each in his particular field of work.

NOTE.—For a full discussion of sweet clover and the details of how to grow it, the reader is referred to Farmers' Bulletin 707. Directions for harvesting and thrashing the crop are given in Farmers' Bulletin 836, and the principal points in its utilization and the palatability of the crop as hay, silage, and pasture are given in Farmers' Bulletin 820. For a comprehensive knowledge of the subject, these bulletins, together with such State publications as are available, should be studied carefully.

seed—that is, seed that has been so treated as to scratch or crack the hard coat and make it easy for moisture to penetrate and hasten germination.

USE OF LIME.

The first and most urgent requirement of sweet clover is lime. Probably more failures with sweet clover throughout the corn belt can be traced directly to lack of lime than to any other one cause. The absolute necessity of lime in growing sweet clover presents a serious difficulty where farms are located at a considerable distance from any shipping point or limestone quarry.

In some sections a ton of finely ground limestone, or one-half that amount of hydrated lime, well worked into the surface soil, will suffice. In many parts of the corn belt, however, it is unwise to attempt to start the crop without a fairly liberal application, preferably of limestone. The necessary application ranges ordinarily from 2 to 3 tons per acre.

If sweet clover is to be rotated over the entire farm lime should be applied to each field before the crop is sown thereon for the first time. An exception to this rule may be made in limestone sections where alfalfa is known to do well naturally, or where actual experiments have shown that sweet clover can be grown successfully without the application of lime. Even in limestone sections it often happens that the surface soil is deficient in lime.

INOCULATION.

Inoculation is very important and should not be neglected. In some sections certain soils have the required bacteria already present, but unless this fact has been fully determined, failure to inoculate either the seed or the soil of the field adds a big element of uncertainty. (For a full discussion of the importance of inoculation, together with the methods employed, see Farmers' Bulletin 797, pages 27 to 29, and for a disenssion of the glue method more especially, Farmers' Bulletin 704, p. 25.)

SCARIFIED SEED.

The sowing of scarified seed often means the difference between a good stand and one that is very poor or even altogether lacking. It is true that much of the seed raised in some sections of the corn belt is sown locally without having the tough seed coat roughened by the process known as scarifying. Good stands are often secured in this way, but generally more seed is required than when scarified seed is used, and the practice entails an unnecessary risk. Scarified seed usually can be secured through local seedsmen at a slight additional expense, or home-grown seed can be sent to seed houses to be scarified at a nominal cost. It is especially important to have sweet

clover seed scarified if it has been grown in a dry climate. (For further discussion of scarifying sweet clover seed and a description of a scarifying machine, see Farmers' Bulletin 979, p. 20.)

FITTING SWEET CLOVER INTO THE FARM SYSTEM.

With preparations made for meeting the preliminary and most important requirements for growing sweet clover successfully, the next step is to consider the crop with reference to the farm as a whole—to the cropping system, the type of farming, and the labor schedule—and to determine the proper relation of sweet clover to the other crops of the farm.

The general characteristics of sweet clover make it an easy matter to place it definitely in any of the rotations or cropping systems common to the corn belt. The introduction of this crop makes possible also new arrangements of crops and systems of farming not now in common use. Sweet clover is a biennial, and fits well in either short or long rotations much the same as common, red, mammoth, and alsike clover, timothy, or mixed hay. Unlike alfalfa, it may be rotated over the entire farm in a comparatively short time. In addition to filling a valuable place in various corn-belt rotations as a hay, pasture, silage, or seed crop, it serves as an emergency pasture or as an extremely valuable crop to be plowed under for soil improvement.

AS A CATCH CROP TO BE PLOWED UNDER.

Sweet clover may be sown between two of the main farm crops of the rotation to serve the purpose of a green manure crop without occupying the land during a full crop season. Grown thus, it makes a better crop for plowing under and gives more growth than any other legume common to the region. If conditions are right the sweet clover will grow with great vigor after the small grain crop in which it is sown is taken off. By late fall it has usually made a growth equivalent to approximately a ton of hay per acre. Sweet clover may be plowed under either in the fall or spring. Some growers prefer not to plow under the fall crop of the first year, for fear that it will come up again the next spring and be troublesome in the crop of corn or oats which is to follow.[1]

The danger of sweet clover coming up and being troublesome when plowed under in the fall depends very largely upon the manner in which the plowing is done. If the plowing is thoroughly done there is little danger in this connection. This, however, is a much disputed

[1] Sweet clover, being a biennial, reaches maturity in the fall of the second year after seeding. The terms "first-year crop" and "second-year crop" are used by sweet-clover growers to designate, respectively, the growth produced during the first year and the second year after seeding.

point among growers in general, and men of considerable experience gave it as their belief that sweet clover should not be plowed under until late in the spring of the second year after seeding. On the other hand, at least one instance was found in which this danger was entirely ignored and without any apparent bad effect.

The practice in plowing under sweet clover followed by Mr. J. M. Neilis, of Lee County, Ill., is believed to be well worthy of consideration in this connection. Mr. Neilis has proved to his own satisfaction that the crop can be plowed under in the fall or early spring without trouble following. For a number of years he has made it a practice to plow down sweet clover whenever it suits his convenience, and it

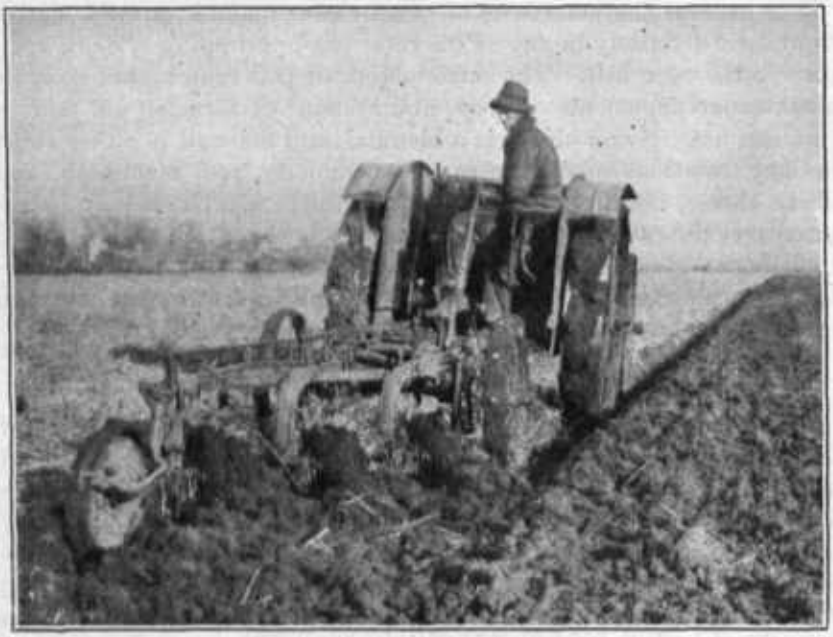

FIG. 1.—Plowing under the first year crop of sweet clover late in the fall after heavy pasturing. A special jointer is used to make sure that all tops are turned under.

has never come up so as to damage other crops which follow. The secret of his success, however, is that he does his plowing well, and insists that everything be turned under completely. The results secured in plowing under sweet clover in this way for a number of years on a farm which is naturally well adapted to the crop and on which it grows vigorously, constitutes strong evidence that sweet clover can be used as a catch crop, and plowed under at the option of the grower, provided the plowing is well done and no tops of the sweet clover are left sticking out of the ground. Figure 1 illustrates the method of plowing sweet clover under followed on the Neilis farm, and shows how well the work is done.

In using sweet clover as a catch crop the most general practice is to wait until comparatively late in the spring of the second year and then plow it under in preparation for corn. The plowing is generally postponed until about the middle of May in order to have a good growth to plow under, and by that time the sweet clover usually will have made a growth approximately equal to a ton of hay per acre. Though May 15 is a little late to plow for corn, farmers are following this practice, depending upon the beneficial effect of the sweet clover plowed under to push the growth of the corn and make up for the delay in planting. In some instances early maturing varieties of corn are used with a special view of permitting of late planting. Generally the yield of corn when planted after a good growth of sweet clover is plowed under is considerably greater than corn planted earlier on similar soil which has not had the benefit of a sweet clover crop.

There is one difficulty in this procedure. In postponing the plowing date until approximately the middle of May, dry weather often makes plowing rather difficult at best, and especially difficult where there is a heavy growth of sweet clover roots. Where the plowing is done with teams, this is a serious matter, but some of the sweet clover growers on the larger farms are meeting this difficulty by the use of tractors.

Whenever it is possible to manage the plowing successfully, this practice becomes a very effective means of soil improvement. In fact, even though used only as a catch crop for plowing under, sweet clover may be well considered a valuable crop for the corn belt.

SWEET CLOVER FOR HAY.

Sweet clover growers generally prefer the fall crop of the first year for hay, since the growth then is finer and the hay is of better quality than at any other time. The hay cut from this crop is practically equivalent to first-class alfalfa hay. Usually there is taken up with it some stubble from the small grain crop in which the sweet clover was sown, but this feature is not objectionable when the hay is for farm use. On soil that is limed and inoculated so as to put it in condition for the best growth of the crop, approximately a ton of hay per acre can be cut in September or early in October. A full crop of grain, such as oats, wheat, or rye, and in addition a ton of first-class hay, make altogether a highly satisfactory return on the land for one season.

In the spring of the second year the growth of sweet clover is more rank and somewhat coarser than that of the preceding fall. Some growers do not use the spring growth for hay, but others cut it regularly and are well satisfied with the results. The spring crop should seldom be cut later than May 26 in the latitude of central Illinois, because of danger of killing the plants, but by that time from a ton to a

ton and a half of hay can usually be taken off, and in exceptional cases even more. At this season of the year curing is naturally somewhat difficult, but by using the side-delivery rake, the hay can be allowed to cure in the windrow for a considerable time without suffering any great damage through exposure to the weather. Live stock in general eat readily the hay cut from the spring crop. If desirable, a second crop of hay can be cut in the early fall of the second year. Where this is done the crop which otherwise would mature seed is cut while in blossom. The grain binder is generally used in cutting this crop and the hay is tied in bunches and shocked in such a way as to permit thorough curing. This hay is rather coarse for cattle, but is excellent feed for horses. Horses and mules will clean up all the roughage with little if any waste. (For full discussion of sweet clover as hay, methods of curing, etc., see Farmers Bulletin 820, pp. 10 to 20.)

USING SWEET CLOVER FOR PASTURE.

Contrary to the general belief that sweet clover is not palatable to stock, this crop is used on some of the more successful farms of the corn belt as the principal pasture crop. There is no trouble in getting live stock to eat sweet clover pasture readily unless the growth is too big and tough before the animals are turned in on it for the first time. Even then there is little trouble unless there is an abundance of other pasturage which is more succulent. The numerous instances of an extensive use of sweet clover as the main pasture crop of the farm are sufficient evidence that, if rightly managed, this crop may be depended upon for pasture purposes throughout the corn belt.

With conditions favorable for its growth, sweet clover, as usually sown in the spring in oats, gets a vigorous start and grows rapidly after the oats crop is harvested. The fall crop of the first year is most excellent pasture. The growth is not coarse or woody and the quality compares favorably with that of the best alfalfa pasture. Owing to the peculiar root system the fall crop of sweet clover may be pastured heavily by all classes of live stock without danger of killing or injuring the stand.

In the spring of the second year sweet clover as a rule can be pastured two or three weeks earlier than any of the other regular pasture crops now in common use. The crop starts growing very early and live stock should be turned in as soon as a good "bite" is available Here again there is little if any danger of injury to the stand from close pasturing. To keep the quality of the pasture good during the spring and early summer of the second year, enough live stock should be grazed to keep it down. If it grows too high it is necessary to clip in order to keep it back and bring out new shoots. It is better usually to pasture heavily enough to make clipping unnecessary. If

it becomes advisable to clip, the cutter bars should be set high enough to avoid killing the sweet clover plants. (See Farmers' Bulletin 820, pp. 12–17.) One of the principal difficulties in pasturing sweet clover comes usually from allowing the second-year crop to get too woody and tough, especially when it is used for hog pasture. Cattle and horses eat the rank growth better than hogs, but often, even for these classes of live stock, the growth must be kept down to get the best results.

When animals refuse to eat sweet clover pasture it is usually because the growth is too rank before they have acquired a taste for it, and if the pasturing is handled properly no trouble is ordinarily experienced in this connection. During the summer of 1917 Mr. W. E. Riegel, of Champaign County, Ill., bought cattle, young horses, and mules from time to time during the entire summer and turned them in on sweet clover pasture. In no instance had the animals been accustomed to eating sweet clover pasture, but no difficulty was experienced in getting them to eat it readily. (For a full discussion of different phases of sweet clover as a pasture crop and some of the results obtained, see Farmers' Bulletin 820, pp. 4 to 10.)

SWEET CLOVER FOR SILAGE.

Sweet clover may be used for silage, but as yet this practice has not become common in the corn belt section. Those who have used it thus, however, are very enthusiastic over the results obtained. Some growers have put the fall crop of the first year in the silo. This crop makes excellent silage, although ordinarily it is preferable as hay. The spring crop of the second year is also used for silage, but the objection is raised that the sweet clover at this time of the year is so watery that it floods the silo and usually much of the juice of the silage is lost. In the early fall of the second year the crop which would otherwise produce seed may be cut with the grain binder while in blossom and put in the silo. In some instances as high as 10 tons of silage per acre have been produced in this way. Doubtless the most economical way of producing ensilage with this crop is to utilize for this purpose the straw left after thrashing the seed crop. In making the silage thus it is essential to wet the straw thoroughly with water while it is being put into the silo. If handled properly this by-product, which otherwise might be wasted, makes excellent feed. (See Farmers' Bulletin 820, pp. 20–22.)

SEED PRODUCTION.

The production of sweet clover seed in the corn belt is one of the greatest difficulties encountered in handling the crop in this section. The seed crop is very difficult to harvest, and the results in general

are somewhat uncertain. (See fig. 2.) The yields vary from a total failure to from 10 to 12 bushels per acre. On the farm of Mr. Frank Barton, Livingston County, Ill., 8 acres of sweet clover in 1917 produced 10 bushels of good seed per acre, which was sold at an average price of $11 per bushel, making a gross income of $110 per acre. At the same time some of the other growers in this section, men who have had several years of experience in seed production, suffered an almost total failure, but practically all of them were at a loss to know definitely why. There are many causes of failure which make seed production a rather doubtful enterprise for the average farmer, especially until considerable experience has been attained.[1] (For a full discussion of seed production see Farmers' Bulletin 836.)

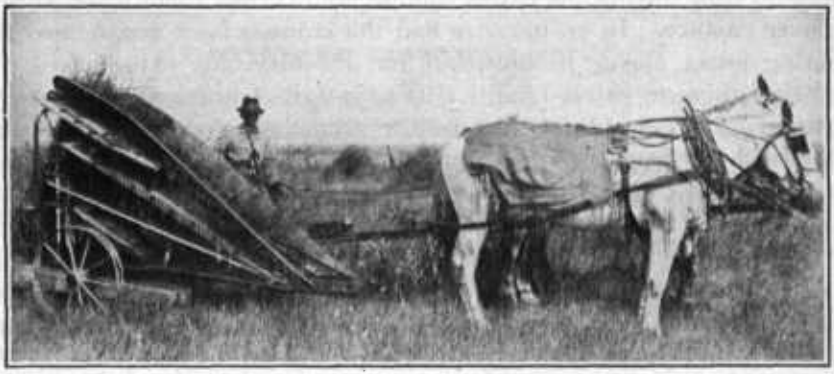

FIG. 2.—If not cut for hay, clipped or pastured, the second-year crop often grows so high that it is necessary to cut the seed crop with the corn binder.

LABOR DISTRIBUTION.

In fitting sweet clover into the cropping system the problem of labor must be considered in its relation to the work necessary on the other farm crops, and the season of the year at which this work must

[1]Aside from the difficulty in harvesting sweet clover seed, thrashing offers another serious obstacle under ordinary conditions. Usually the crop is first run through a grain separator and afterward the unhulled seed, chaff, etc., which is secured in this manner is then run through a clover huller, the latter operation being necessary in order to hull the seed successfully. The lack of experience of local thrashers in handling the crop is often a serious matter. This was the case with the 1917 crop on one farm in La Salle County, Ill., where out of a yield of probably 8 bushels per acre, only 2 bushels per acre were secured.

When it is necessary to use both the grain separator and clover huller, thrashing sweet clover seed becomes a rather undesirable job. It is now claimed, however, that some makes of grain separators, by means of special attachments or adjustments, thrash the seed successfully and hull it in the same operation.

Where the ordinary separator is used and the clover huller is not available, the seed can be hulled very satisfactorily by running it through a fanning mill and then through an ordinary power feed grinder. The average grinder will handle about 25 bushels of unhulled seed per hour. After being run through the grinder, the seed is again run through the fanning mill. The grinder hulls the seed satisfactorily and also cracks and destroys such weed seed as fox tail, which is often a very important consideration. This method, however, requires considerable labor unless the fanning mill is driven by power.

be done. While there is some conflict in labor between sweet clover and other crops, with reasonable acreages the extra work can be managed without great difficulty, and it should not be considered a serious objection to growing sweet clover as a major crop.

Both as a matter of convenience and for best results, the seeding of sweet clover is generally done in the spring and in a way that requires very little extra labor. The seed is sown with oats or barley, or, in some instances, on fall-sown grain such as wheat or rye. The seeding is usually done in the latter part of March or early in April. The principal reason for not sowing in the fall is that the sweet clover plants do not then have time enough to develop a strong root system and, except on sandy soil, there is much danger of winter killing.

Figure 3 (p. 12), based on data gathered throughout the central section of the corn belt, shows when the various operations with sweet clover occur, and how these different operations fit in with the work that must be done on the other crops of the region.

It will be noted that the first and practically the only labor conflict between sweet clover and the other crops of the region comes in the cutting of the sweet clover hay crop in the spring of the second year. This operation occurs in the midst of preparation of seed bed, planting, and first cultivation of corn, when each day's work is of vital importance. However, by the proper methods of securing and handling the hay, this objection loses much of its importance. Comparatively little time is required for cutting the crop and by the use of rapid methods with the side delivery rake and hay loader, as discussed under "Sweet clover for hay," page 7, the work on the sweet clover crop at this time of the year may be done without serious delay or derangement of the general labor schedule.

There is, of course, a limit to the acreage of hay that can be handled on the average farm during the latter part of May and early in June, and if the total sweet clover acreage is greater than can be put up as hay at this time, a part of the spring crop of the second year may be pastured, clipped, or plowed under. Because of the rush of work at the time when the spring crop must be handled if cut for hay, many sweet clover growers prefer to pasture the entire crop heavily in the spring and thus avoid this difficulty entirely. Clipping the crop and allowing it to lie on the ground as a means of soil improvement accomplishes the same end. Thus the labor conflict caused by cutting the spring crop for hay may be avoided and the difficulty need not be considered a serious objection to making sweet clover an important part of the farm system.

FARM SYSTEMS WITH SWEET CLOVER IN THE ROTATION.

On grain or crop farms usually a small acreage of sweet clover furnishes all the hay and pasture needed, leaving the greater part of the crop to be plowed under to enrich the soil. After the details of

handling the seed crop have been worked out the sale of sweet clover seed may become an additional source of cash income. Usually in the beginning it is better practice to plow under most of the crop rather than attempt seed production, but where the seed crop can

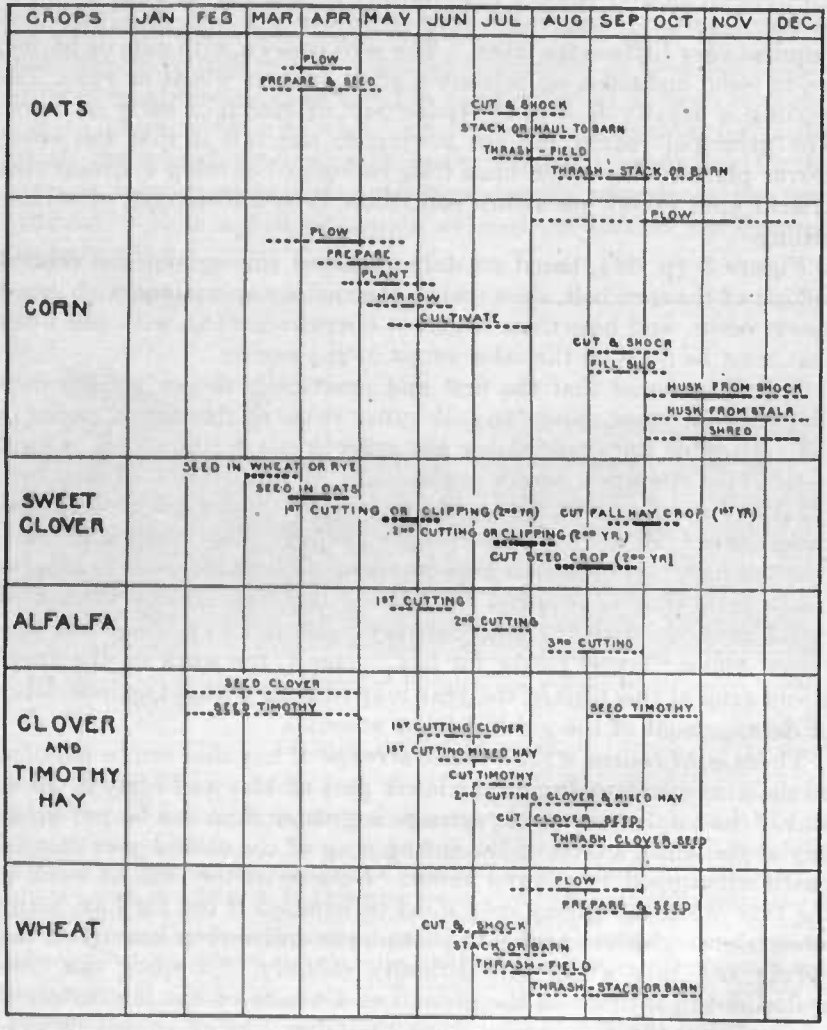

FIG. 3.—Distribution of labor as usually performed on the principal farm crops of the corn belt. The solid lines represent the average dates when the different operations are usually performed; the dots represent the extreme limits within which the work may be done.

be managed properly sweet clover will serve both purposes to good advantage.

On combination grain and live-stock farms, sweet clover serves even a better purpose. It promotes the keeping of live stock because

of the hay and pasture it produces as a part of the rotation, and as a mixed seeding with bluegrass it furnishes a pasture with greatly increased carrying capacity.

TWO-YEAR ROTATIONS WITH SWEET CLOVER MAINLY AS A CATCH CROP.

A GRAIN FARM.

A good example of a two-year rotation, subject to slight variations as emergency dictates, was found in Ogle County, Ill. After some eight years of experience in farming with sweet clover Mr. W. P. Graham has worked out a very satisfactory system of this kind for three farms, which are rented out on a share basis, the rent being taken in grain delivered at the elevator. The rotation is as follows:

First year_____ Corn.
Second year_____ Small grain—oats or wheat, with a seeding of sweet clover.

This general plan is not always strictly adhered to. Occasionally corn or small grain is grown for two successive years on the same field, but in any event it is a strict rule that as soon as any part of the farm is sown to small grain it is seeded at once to sweet clover, which is pastured in the fall, if need be, but which is allowed to grow up the following spring and is then plowed under for corn. Generally speaking, corn and small grain alternate on the different fields, with sweet clover as a catch crop to be plowed under in the preparation for corn. By this plan a legume is grown in the cropping system which affords a hay crop in the fall, if desired, or its equivalent in pasture, and in the spring a heavy growth to be plowed under. The farms on which this plan is carried out, it might be added, were formerly in a very low state of fertility. By this plan, no time is lost in the production of crops for sale and the plowing under of sweet clover together with the application of phosphorous and lime is increasing production rapidly.

Formerly it was specified in the leases that a certain amount of sweet clover seed was to be produced on each farm, but the many difficulties which the tenants experienced in handling the seed crops, and the many objections which they raised to following out this program, finally forced the owner to adhere strictly to the plan of seeding all small grain to sweet clover and plowing the crop under in preparation for the following corn crop.

A serious difficulty in carrying out this system is that sweet clover must be left growing until about May 10 in order to obtain the most suitable growth for plowing under. At this time of the year the combination of dry weather and the strong sweet clover roots in the soil often makes plowing very difficult. Furthermore, when left until this date the plowing must be done quickly in order to get the corn crop planted in the proper season. Thus far it has been pos-

sible to handle this situation with horses, but it is planned to purchase a tractor for the purpose of speeding up the plowing operations on the different farms whenever necessary.

By May 10 the sweet clover crop usually attains a growth which would make practically a ton of hay per acre. This growth, together with the extensive root system which this crop develops and the nitrogen which the root nodules have gathered, has a very beneficial effect on the productiveness of the soil. For a grain farm it would be difficult to plan a better system of soil improvement than this or one that could be carried out with such little loss of time in the production of salable crops and with such small extra expense.

Figure 4 shows a general plan of the farm on which most of the work with sweet clover has been done.

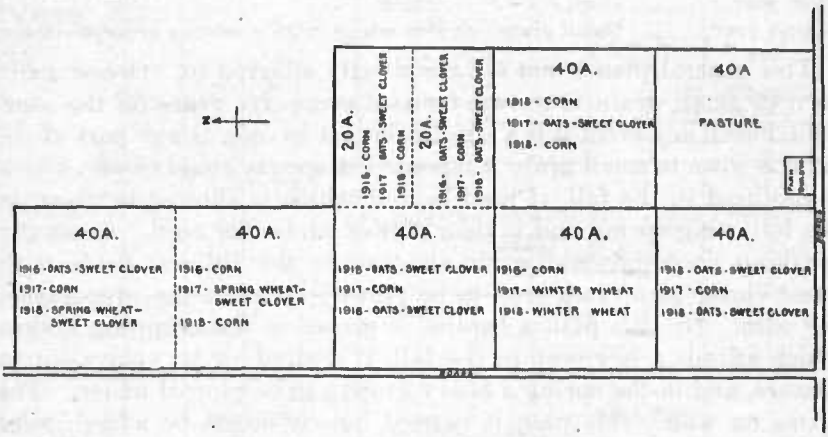

FIG. 4.—General plan and cropping system of a 320-acre grain farm in Ogle County, Ill.

A MIXED SYSTEM.

In Lee County, Ill., there is a 360-acre combination grain and live-stock farm operated by the owner on a modified two-year rotation plan, using sweet clover in part as a catch crop to be plowed under and in part as hay, pasture, and seed. The system followed has certain characteristics of grain farming. Large quantities of oats and corn are sold, but in addition about 120 cattle and 140 hogs are bought and fed each year. The crop yields on this farm are high. In 1915 the entire corn crop averaged 77 bushels per acre by weight. The year 1917, being an exceptionally good year for oats, this crop averaged 94½ bushels per acre. Figure 5 gives an idea of the general plan of this farm and the arrangement of the fields.

It will be noted that there are irregularities in the cropping system. In some instances corn is grown twice in succession in the same field and to a lesser extent this is true of oats. Corn and oats are the only grain crops grown, and the most regular feature of the system is that

all of the oats seeding is sown to sweet clover. On some of the fields the first year sweet clover is plowed under in preparation for corn, thus affording a catch crop in a two-year rotation. Each year, also, certain fields of sweet clover seeding are reserved to produce hay in the spring of the second year and a seed crop later in the fall, thus lengthening the rotation on this part of the farm from one to three or more years.

More or less pasturing is done on the sweet clover seeding, especially in the fall of the first year, after the oats crop has been harvested; but the spring crop of the second year is not pastured to any great extent. A part of the spring crop is reserved to produce hay and if the acreage is greater than is needed for hay a part of the crop is clipped and left on the field. The seed crop is produced on

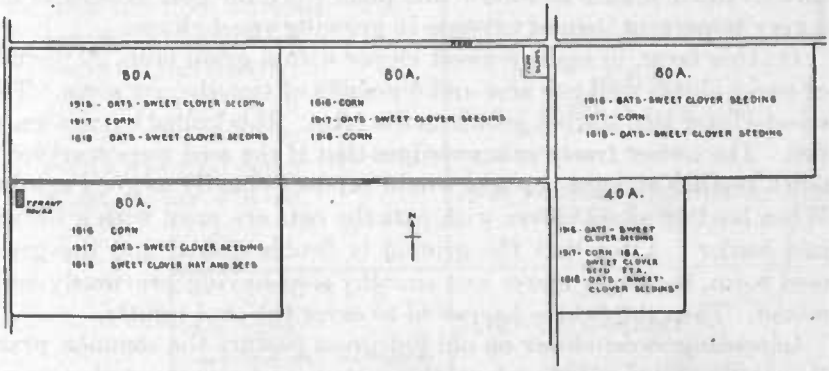

FIG. 5.—Plan of a 360-acre grain and live stock farm run with sweet clover as the only grass crop (Lee County, Ill.).

the acreage thus clipped or on that cut for hay. After the seed crop is harvested and thrashed the straw is made into silage and is fed to steers during the winter season. This by-product which otherwise would be wasted is turned into good profit by this process.

THREE-YEAR ROTATION WITH SWEET CLOVER FOR PASTURE, HAY, AND SEED.

A GRAIN AND LIVE-STOCK FARM.

Some very successful and effective work in the growth of sweet clover as a farm crop has been done by Mr. Frank Coverdale, of Clinton County, Iowa. The early experimental work dates back approximately 21 years, and for about 20 years sweet clover has been grown extensively as one of his main crops. After the preliminary work a general system was formulated which conforms roughly to a three-year rotation as follows:

First year_____ Corn.
Second year_____ Oats, barley, or spring wheat, with a seeding of sweet clover and timothy.
Third year_____ Sweet clover and timothy.

The field in sweet clover and timothy is often pastured for several years before the rotation is repeated, but in some instances the rotation is continued regularly. While a field is being pastured, the pasturing is so regulated that sweet-clover seed is produced and seed crops cut; thus when the land is returned to small grain again there is generally enough shattered seed in the ground to produce a volunteer seeding of sweet clover. Usually a seeding of timothy is made with the small grain, but after a field has once been put in condition to grow sweet clover, having been limed and inoculated, the owner of this farm generally relies on the volunteer crop to furnish a stand of sweet clover. This is feasible, however, only in a short rotation like this, in which sweet clover is allowed to go to seed on the land from year to year. Under most conditions it would doubtless be taking an unwarranted chance to follow this plan, since the cost of seed is not a very important item of expense in growing sweet clover.

On this farm, in seeding sweet clover with a grain crop, 20 pounds of sweet-clover seed per acre and 6 pounds of timothy are sown. The sweet-clover seed sown is grown on the farm. It is hulled but not scarified. The owner freely acknowledges that if the seed were scarified a much smaller amount per acre would produce equally as good results. When seeding sweet clover with oats the oats are sown with a broadcast seeder. After that the ground is double disked and the grass seed sown, the sweet clover and timothy seed having previously been mixed. Then the field is harrowed to cover the seed lightly.

In seeding sweet clover on old bluegrass pasture the common practice on this farm is to break up the pasture and sow sweet clover and timothy without a nurse crop. This method on parts of the farm is giving a fairly good stand of sweet clover on old pastures without liming, but much better results are obtained after lime is used. On fields that have grown general farm crops for several years, liming is absolutely necessary. On such fields there is a good stand of sweet clover where lime has been applied and no stand whatever where there is no lime.

The farm is run as a grain and live-stock farm, though the live stock features generally predominate. Following is the average amount of live stock kept: Horses, 8; colts, 4; cows, 5; calves, 5; brood sows, 30; shoats, 180; and feeding or grazing steers, 60. The brood sows which raise only one litter of pigs, the spring litter, are kept only one season, being fattened after the pigs are weaned, and sold, usually by the latter part of August. As a side line 300 stands of bees are kept which produce large quantities of honey from the sweet clover and from alsike, which continues to volunteer on certain fields of the farm. The general plan and cropping system are shown in figure 6.

The part of the farm south of the road is devoted mainly to the hog industry, although the hogs at different seasons of the year have

access to other parts of the farm also. In 1917 the hogs were given the fields in sweet clover and bluegrass as pasture, and the 13-acre field was in corn, which was hogged down. The process usual on this farm, in seeding for hog pasture, is to plow and seed to oats, sweet clover, and timothy. The oats crop is used as hog pasture as soon as it is up 2 or 3 inches. As the oats crop is eaten off the sweet clover comes on and carries the hogs through the remainder of the season. This has been a regular practice for a number of years. After the first year care is taken to pasture the field in such a way that some sweet clover will be

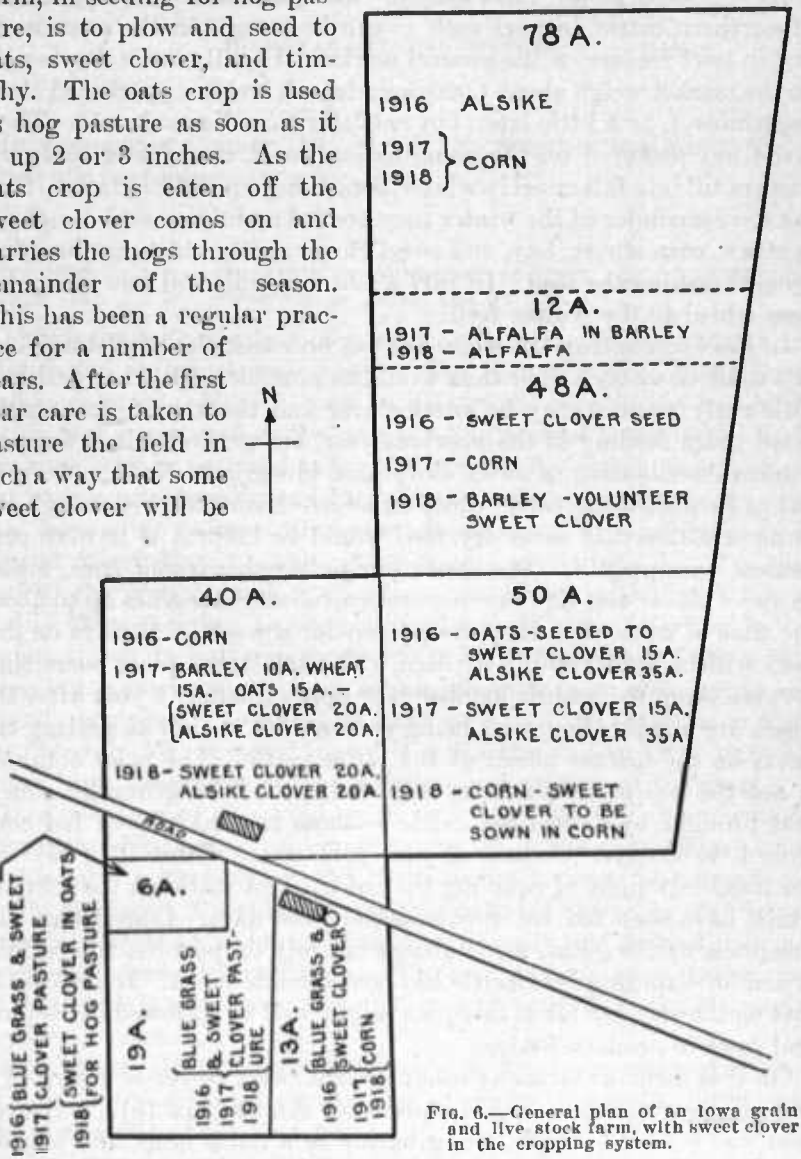

FIG. 6.—General plan of an Iowa grain and live stock farm, with sweet clover in the cropping system.

allowed to go to seed, but after the second or third year the field is generally reseeded again, since hogs graze so close that it is not always possible to allow enough of the crop to go to seed

to make a volunteer seeding that will keep up a good stand of sweet clover.

The system of beef production followed on this farm is an important feature of the farm system. The plan calls for the purchase of northern cattle, in part such as can be bought in the community and in part feeders on the general market. Usually the steers bought on the market weigh about 1,000 pounds each and are purchased about September 1, or a little later, but not later than November 15. These cattle are pastured on the combination sweet clover and bluegrass pasture till late fall or early winter, sometimes up to Christmas. During the remainder of the winter they are fed mainly on such roughage as straw, corn stover, hay, and sweet clover straw which has been left from thrashing the seed. In 1917 a silo was built and now silage has been added to the winter feed.

In the early spring the steers are put on sweet clover pasture from two to three weeks earlier than would be possible with other pastures. This early pasture may be sweet clover and timothy, following the small grain seeding of the previous year, but generally it is the permanent combination of sweet clover and bluegrass. No dry straw or hay is furnished the cattle while on sweet-clover pasture, though the owner realizes that some dry feed would be helpful if it were convenient to supply it. The steers are pastured, without corn, either on sweet clover and timothy or sweet clover and bluegrass up to about the time of sale, when they are put up for a week or 10 days on dry feed with a light feeding of corn. The sale takes place some time between August 1 and September 1, or approximately a year after the steers are bought, that time being chosen with a view to getting the steers on the market ahead of the range cattle. The price obtained is not the top price for fancy corn-fed cattle, but generally equals that brought by "short-fed cattle"—those that have been fed corn from 40 to 60 days. Occasionally the price comes within 10 or 15 cents per hundredweight of equaling that of the best cattle on the market, which have been fed for approximately 150 days. Considering the cheapness of the gains, made almost entirely on pasture, this unique system of handling beef cattle has considerable merit. It is possible that on the cheaper lands this plan might well be followed in keeping beef cows to produce feeders.

On this farm, as on many others where sweet clover is grown in a cropping system, there is still a place for alfalfa. In 1917, a 12-acre field was sown to alfalfa, using barley as a nurse crop, and a good stand was secured, the field having previously grown sweet clover and having received a good application of limestone. The plan now is to depend chiefly on alfalfa for hay and use the sweet clover to produce seed and pasture and to plow under as a soil improvement

crop. The practice of growing sweet clover with bluegrass for pasture and seed will be continued. The owner of this farm owns several other farms and is endeavoring to get them all in line with the system used on the home farm.

FOUR-YEAR ROTATION SYSTEMS.

A HOG FARM.

In Livingston County, Ill., Mr. C. E. Stratton has adopted the following four-year rotation:

First year.....Corn.
Second year.....Corn.
Third year.....Oats, with a seeding of sweet clover, alsike, and timothy.
Fourth year.....Sweet clover, alsike, and timothy.

This farm is primarily a hog farm, and the cropping system is arranged and managed accordingly. The corn occupies one-half the land in rotation. Rape is sown in part of the corn in the last cultivation and is pastured as the corn is being hogged down in the field. The first crop is pastured to a point where clipping during the second year is unnecessary, and little, if any, seed is produced. In case it is impossible to keep the sweet clover down by pasturing, it is clipped about May 15, and, if necessary, again in July. By this method the crop is made to produce new shoots, and thus a better quality of pasturage. In clipping, and even in cutting for hay in the spring, the grain binder is used so as to cut the sweet clover at a considerably greater height than is possible with a mower, unless especially equipped. In order to make sure to avoid injuring or killing the crop, Mr. Stratton makes it a practice to clip from 12 to 18 inches high, according to the condition and growth of the crop.

In a rotation of this kind, with two years of corn in succession, very little volunteer sweet clover comes up in the oats. The owner of this farm is very certain that with such a rotation no dependence should be placed in a volunteer seeding of sweet clover, as may sometimes be done with a shorter rotation with only one year of corn intervening between the oats crops. The seed mixture as sown per acre on this farm is as follows: Sweet clover 15 pounds, alsike 2 pounds, timothy 2 pounds.

At present, alfalfa is grown for hay on 9 acres outside of the rotation, but in addition hay is often cut from the sweet clover crop late in the fall of the first year.

SWEET CLOVER WITH OATS AND WHEAT.

Another four-year rotation with sweet clover, especially to be recommended at the present time when there is need of concentrated

effort in the production of wheat, provides for wheat occupying one-fourth of the crop area. The following is the plan of rotation:

First year.....Corn.
Second year.....Oats, with a seeding of sweet clover as a catch crop.
Third year.....Wheat, with a seeding of sweet clover.
Fourth year.....Sweet clover for hay and seed.

After the soil has been put in condition to grow sweet clover properly a catch crop of sweet clover for plowing under should be sown in the oat seeding of the second year in the rotation. By the time the oats crop is harvested the sweet clover will generally be so tall that some of the tops will be clipped off and harvested in the bundles of oats, and by the time the oats crop is thrashed and the plowing for

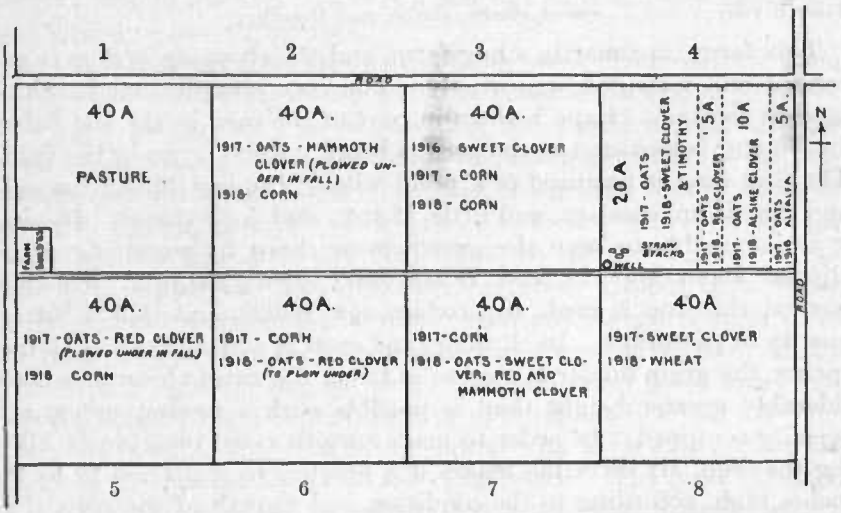

FIG. 7.—General plan of a 320-acre grain and live stock farm with sweet clover in the cropping system (Livingston County, Ill.).

wheat is started, a very good growth will be ready to be plowed under. This plan can be carried out at a very small expense of seed, and the growth plowed under is highly beneficial to the wheat crop. When sweet clover is plowed under thus in the summer, there is little if any danger of it coming up in the wheat the following year to the extent of being troublesome or injurious.

In Livingston County this rotation is being carried out by Mr. H. J. Meis with considerable success. The farm proper is 320 acres in area with an addition of 80 acres of bluegrass pasture, which is located about one-half mile away, but which is run as a part and in connection with the main farm. Figure 7 shows the arrangement of the fields and the general plan of the farm proper.

There are really two cropping systems in use on this farm. The west half, being close to the farm buildings, receives all the manure

produced and is run on an irregular plan without sweet clover. As yet the sweet clover is grown entirely on the east half of the farm, where no manure is applied on account of the long haul.

The present plan of arrangement is to use sweet clover principally for pasture, both in the fall after the seed crop is taken off and in the spring of the second year. The spring pasture season is usually prolonged until July 1, no hay being cut from the spring crop unless there is shortage of feed. As a rule, also, this crop is not clipped, enough live stock being kept to pasture it heavily instead, thus avoiding the danger of killing the seed crop by cutting or clipping too close to the ground. The fall crop of the second year is generally cut for seed. Sometimes, however, when feed is needed and it seems undesirable to cut for seed, this crop is cut for hay or silage when in blossom, using the grain binder, which leaves the crop in bundles, making it easier to cure and handle, and, in addition, leaving a heavy stubble to be plowed under. If sweet clover is cut while yet in blossom and before the seed forms, there is occasionally a considerable additional growth which springs up from a crop that is cut just for hay or silage. In this way this method of handling the crop affords considerable additional material to be plowed under. While the hay produced is rather coarse, horses eat it readily and clean it up with practically no waste. When put into the silos the coarser part of the hay softens and practically all of it is consumed by cattle.

The plan of having a bluegrass pasture as a separate enterprise, outside the regular rotation, and in some instances apart from the main farm, to serve as an emergency grazing ground to or from which live stock may be transferred at any time, has been found in operation on a number of farms where sweet clover is being grown. On this farm such pasture is mainly used to carry beef calves and steers and a few beef cows which are kept to produce calves, also to pasture general live stock when other pasture is poor. The cattle and general live stock usually are pastured on the main farm in the fall and early spring when sweet clover affords the greatest amount of pasturage. In this way it is possible to have an abundance of first-class pasture during the greater part of the year. Mr. Meis ships from one to two carloads of cattle annually, marketing them direct from his pastures.

The part of the main farm on which sweet clover is grown is conveniently arranged for pasturing live stock. In referring to figure 7, it will be noted that in the corner of field 4, which joins fields 3, 7, and 8, there is located a well from which live stock can be watered in each of the four fields. The oats, wheat, and the sweet clover seed crop are thrashed so that the straw therefrom will be left in the sweet clover field which is to be pastured, and gen-

erally in the corner nearest the well. It is considered very important to allow cattle to have access to a straw stack or some other form of dry feed when pasturing on sweet clover, especially in the early spring. Cattle will thus consume large quantities of straw, and it is claimed they do much better than when no dry roughage of any kind is available. Furthermore, this plan furnishes a good means of turning into profit straw stacks which might otherwise be allowed to rot.

There is another farm in Livingston County, the owner of which, after considerable experimenting with sweet clover, has adopted this same 4-year rotation system including wheat. This farm, of 310 acres, owned and operated by Mr. C. B. Meis, is run primarily as a grain farm. The owner and one man operate the farm with extra help in corn cultivation and corn husking.

By experience it has been found that on this farm, as on a very large number of farms in central Illinois, sweet clover can be grown fairly well in the slight depressions in the fields without the application of lime, while on the slight elevations and knolls it is almost an entire failure, unless lime has previously been applied. It is rather a big undertaking to apply from two to three tons of limestone per acre over the entire area of a farm as big as this one. At present, the plan adopted is to lime the higher points of each field first, and the remaining areas later. Until these slight elevations can all be limed, Mr. Meis, like many other growers in beginning with the crop, is sowing a mixture of one-half sweet clover and the other half composed of red and mammoth clover mixed. In addition to this seeding, timothy, also, is sown on the higher ground. On the unlimed elevations the stand consists almost entirely of red and mammoth clover and timothy; whereas in the depressions of the fields sweet clover holds sway almost entirely. The sweet clover is pastured as the occasion demands, but is grown mainly to supply hay for farm use and to produce seed.

A GENERAL LIVE-STOCK SYSTEM.

A good example of a four-year rotation on a live-stock farm which grows sweet clover extensively is afforded by the McHarry farm in Champaign County, Ill. This is primarily a hog farm and is unique in that the rotation differs greatly from those commonly followed in the corn belt:

First year.....Corn.
Second year.....Soy beans.
Third year.....Wheat, with a seeding of sweet clover and pasture mixture.
Fourth year.....Sweet clover and mixed pasture.

This rotation has been worked out by a series of yearly records kept on the different crops to determine the cost of production and

the net gain from each. It is planned more especially with reference to the needs of hog production, sweet clover being used mainly as a pasture crop.

The farm being 800 acres in area, it has been found impossible as yet to apply lime to all fields, although liming is being done as rapidly as conditions will permit. Sweet clover is sown in a mixture of the following proportions: Sweet clover 4 pounds, red clover 3 pounds, alsike 1 pound, timothy 2 pounds. In that way a stand of grass of some kind generally is secured each year on the entire field sown, since it is seldom that all of the crops will fail at the same time on any one part of the field.

A FIVE-YEAR ROTATION PLAN.

A rather unusual system which embodies the use of sweet clover in a five-year rotation, with alfalfa on a part of the farm set aside

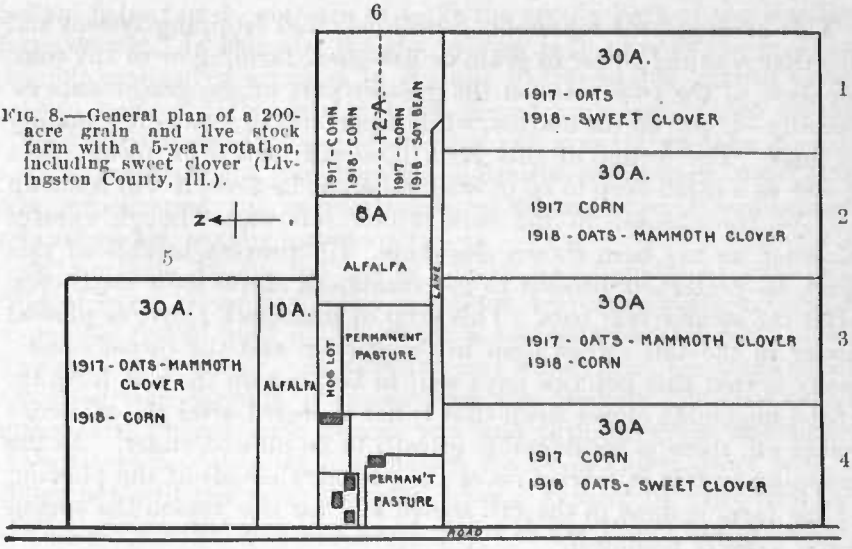

FIG. 8.—General plan of a 200-acre grain and live stock farm with a 5-year rotation, including sweet clover (Livingston County, Ill.).

especially for pasture and hay, has been worked out by Mr. I. J. Gallup on his farm in Livingston County, Ill. This is one of the most thorough systems that have been found on sweet-clover farms. The farm is run on a grain and live-stock basis, with the selling of crops predominating considerably. Hogs afford the main source of income from live stock and plans are being made to increase this enterprise. The usual amount of live stock kept at present is as follows: Work horses 9, colts 3, cows 5, calves 5, sows 10, spring shoats 48, fall pigs 38.

The general plan of the farm and lay-out of the fields are shown in figure 8.

It will be noted in figure 8 that the main part of the farm is divided into five 30-acre fields. These fields were surveyed carefully to get

exact acreage, leaving the part of the farm nearest the farm buildings for irregular fields, which are devoted to permanent pasture, alfalfa, and emergency crops. Of these smaller acreages, field 6 is devoted one-half to corn and the other half to soy beans, these crops being alternated from one side of the field to the other. The greater part of both crops is hogged off, though some of the soy beans are cut as hay for winter feeding of hogs. At the last cultivation soy beans are also sown in the corn to furnish pasturage while this crop is being hogged off. On the five 30-acre fields the following rotation is carried out:

First year.....Corn.
Second year.....Oats, with a seeding of mammoth clover as a catch crop.
Third year.....Corn.
Fourth year.....Oats, with a seeding of sweet clover with some alsike and timothy.
Fifth year.....Sweet clover.

This arrangement represents a well-balanced cropping system and one that is suited either to grain or live-stock farming or to any combination of the two. As yet the greater part of the grain—oats especially—is put on the market, while a part of the corn is fed, mainly to hogs. The owner of this farm does not believe in using sweet clover as a catch crop to be plowed under, as he fears it will come up and be troublesome in the corn which follows. Though careful plowing, as has been shown elsewhere, will prevent trouble of this kind, he prefers at present to use mammoth clover as a catch crop after the second year oats. This crop of mammoth clover is plowed under in the fall rather than in the spring, and the owner's testimony is that this practice pays well in keeping up the soil fertility. If the mammoth clover sown thus is not pastured after the oats crop comes off, there is considerable growth to be plowed under. As the cropping system is carried on at the present time all of the plowing of the farm is done in the fall season and for this reason the spring work is easily managed.

Thus far it has been impossible to apply lime to the entire acreage of the farm under rotation. Hence, conditions are not altogether ideal for growing sweet clover. Sweet clover grows well without lime in the slight depressions in the different fields of the farm, but on the knolls, even on very slightly elevated ground, the stand is very poor or altogether lacking until lime has been applied. Since these high spots are not numerous it has been a question whether to go to the expense of liming in order to have the entire acreage prepared for growing the sweet clover. The owner, for the present at least, will adopt a plan of liming the higher elevations first. Until these elevations have been limed the plan is to sow a mixture of sweet clover 10 pounds, alsike 6 pounds, and timothy 6 quarts per acre. In this way a stand of grass is secured over the entire area sown. In the low

grounds sweet clover is the principal crop, while alsike and timothy are more in evidence on the elevations.

On this farm the sweet clover and mixed seeding generally are used for pasture in the fall after the oats crop is taken off. In the spring of the second year a hay crop is cut and the second crop is harvested for seed. The owner of this farm has had considerable experience in the production of seed and has his harvesting machinery fairly well equipped with pans and extra attachment for catching the seed which shatters while cutting the crop. He is strongly of the opinion that the beginner will do well not to try to produce a seed crop at first.

GROWING SWEET CLOVER FOR SOIL IMPROVEMENT ONLY.

There are a number of instances where farmers in the corn belt grow sweet clover for the express purpose of soil improvement on certain fields but do not care to make the crop a part of the regular farm system. In this case the end in view is to provide the greatest possible amount of nitrogen in the soil and vegetable growth to be plowed under. It is clear that the second year crop which would otherwise be devoted to seed production will give the greatest growth for soil improvement, but there are difficulties in plowing under this crop which must not be overlooked, as certain special methods of procedure are usually necessary.

At Rochelle, Ill., in the fall of 1917 it was found that a certain field of sweet clover had failed to mature a profitable seed crop and it was decided to plow it under with a 4-horse team and gang plow. The growth, however, was so heavy and woody that the team could not be driven through it except with the greatest difficulty. The knees of the horses soon became raw and little progress was made. An attempt was then made to flatten the sweet clover down with a roller but still the same difficulty arose. Finally by crowding the team close into the standing sweet clover it was found that a narrow strip could be rolled down without forcing the horses to penetrate the standing growth. This process, however, was very slow. The field was finally plowed, but with extreme difficulty and the farmer who had the disagreeable experience will hereafter avoid any such undertaking.

If sweet clover is produced merely with the idea of getting a large amount of growth to be plowed under, and, if it is necessary to do the plowing with teams, a different method should be adopted. The fall crop of the first year may be cut for hay without lessening to any great extent the amount of material finally returned to the soil. About the middle of May the second year crop may be clipped from 8 to 12 inches high and allowed to remain on the ground. In order to prevent too heavy a growth the crop may be clipped again early

in July, this time from 12 to 18 inches high if possible. This clipping also remains on the field. After the second clipping, considerable growth and some seed will be produced, all of which, together with the two clippings, may be plowed under later in the fall without special difficulty.

When a tractor is available, however, clipping is unnecessary, and if the proper equipment is used a very heavy growth of the fall crop of the second year can be plowed under very satisfactorily. On several occasions large acreages of sweet clover, which have failed to produce seed, have been plowed under by the use of a tractor and gang plows with special jointers which are very effective in turning under large amounts of vegetable matter of this kind.

SWEET CLOVER IN BLUEGRASS PASTURES.

The combination of sweet clover and bluegrass in pastures offers a number of distinct advantages. Both crops grow well together, even when there is a perfect stand of each. The sweet clover adds nitrogen to the soil and where the stand of bluegrass is poor the grass soon thickens up and produces a much better stand than it would without sweet clover. Furthermore, the sweet clover adds greatly to the total amount of pasturage produced and gives a longer pasture season. It comes on in the spring two to three weeks earlier than most other grasses and the live stock can be turned out to pasture just that much sooner than otherwise would be possible. In some instances this combination has more than doubled the carrying capacity per acre of bluegrass alone. A first-class pasture of this kind will more than carry two 1,000-pound steers per acre in the spring and early summer, and, as a usual thing, will carry more than one such steer per acre during the remainder of the pasture season.

If not pastured too heavily the sweet clover will produce seed enough to re-seed the pasture, and often a crop of from 3 to 8 bushels of seed can be harvested per acre in addition to the pasturage produced throughout the season. The experience of a few men is that when such a combination pasture is handled in this way it will maintain itself from year to year and it is unnecessary to sow any great amount of seed to keep up the sweet clover in combination with bluegrass.

The pasture shown in figure 9 is a good example of a sweet clover and bluegrass combination. There is a perfect mat of bluegrass in addition to the sweet clover, and both crops make a vigorous growth. This pasture is located along a railroad and is used for pasturing western sheep that are unloaded and held for a period before shipping on to the Chicago markets. The number of animals on this pasture varies greatly and it is difficult to get an estimate of its carrying capacity, since it is not pastured up to its full capacity all of the time

and the sheep do not keep the sweet clover down. Even after it has grown up, and after seeding has become dry, they continue to reach up and eat off the branches.

A splendid example of this sweet clover and bluegrass combination pasture is found in Ogle County, Ill., in a tract of 320 acres in area, which is run as an enterprise separate from three farms which the same owner rents out on a grain basis with sweet clover in the cropping system as a catch crop. This pasture has never been plowed. In getting a stand the owner simply sowed sweet clover seed broadcast on one-half of the pasture one year and on the other half the next. It was pastured constantly as if no seeding had been made and a good stand was secured in both instances. As a result of the seeding having been done on alternate years, one-half of the field produces a seed crop

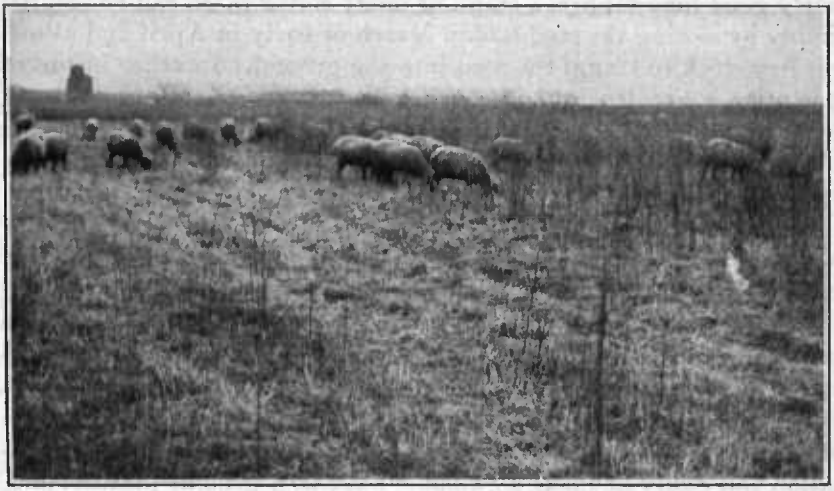

FIG. 9.—A valuable combination of sweet clover and blue grass pasture (Ogle County, Ill.).

while the other half produces the first-year growth of sweet clover preparatory to producing a seed crop the next year. After the early spring the live stock are induced to graze principally on the half of the pasture that is not producing seed, which permits the seed crop to develop comparatively unmolested.

A farmer of Clinton County, Iowa, has had unusual success in the seeding of sweet clover in one of his worn-out fields that had been cropped with corn and oats continuously for about 40 years, mainly without being seeded to grass. Sweet clover was sown with timothy, and bluegrass came in, so that in a few years there was a perfect stand of sweet clover and bluegrass. After many years the field still produces annually an extremely luxuriant growth of this pasture combination. The pasturing has usually been done with sufficient care to permit the sweet clover to produce some seed each year. A seed

crop is cut, in addition to the pasturing, and enough seed shatters off to reseed the field from year to year. Under this system of management it has been found necessary to sow but little sweet clover seed to keep the stand in good condition. No manure or fertilizers have been applied, but the pasturing of cattle and the nitrogen produced by the sweet clover have built the field up from extreme depletion until its carrying capacity is fully double that of the average bluegrass pasture of the neighborhood.

In establishing a combination sweet clover and bluegrass pasture the problem of getting a stand, as compared with the growth of sweet clover in rotation, is fundamentally different. In some instances the pasture must be plowed, limed, and seeded anew.

On old bluegrass pastures of long standing, which still have a fairly good lime supply, a stand of sweet clover often can be secured simply by sowing the seed late in March or early in April and allowing live stock to tramp the seed into the ground. In other instances it is more convenient to start such a pasture on a part of a rotation area, a seeding of sweet clover and timothy being made in the oats after the necessary application of lime, the bluegrass being allowed to come in of its own accord.

To determine the method that will succeed in getting a stand of sweet clover and bluegrass for pasture, it will generally require some experimenting, as local conditions vary greatly.

Perhaps there is no use for sweet clover that gives such promise and that seems to lend itself to such wide application as this combination of sweet clover with bluegrass for pasture. It produces a pasture of such quality and carrying capacity as to make it profitable generally even on high-priced land. On cheaper lands this combination can easily be made a valuable asset as a general pasture, and, in addition to reducing the cost of keeping all branches of live stock, can well be made an important factor in economic and profitable beef production.

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